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REPORT ON
THE USE OF CYGON
AS AN EXPERIMENTAL INSECTICIDE AGAINST
THE SPRUCE BUDWORM

1964



DIVISION OF TIMBER MANAGEMENT

Forest Service
U. S. Department of Agriculture
Ogden, Utah

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U. S. FOREST SERVICE
REGION FOUR

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THE USE OF CYGON AS AN EXPERIMENTAL
INSECTICIDE AGAINST THE SPRUCE BUDWORM

By
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I. ABSTRACT

Several new insecticides have been developed recently which are low in toxicity to fish and wildlife. One of these, Cygon, an organic phosphate insecticide, has shown promise in spruce budworm control in small tests outside of U. S. Forest Service Region Four. It has been extensively tested and proved effective against a number of economic pests in forage and field crops. It has shown systemic action when applied to the soil or foliage of plants.

In 1964 a pilot project was scheduled to test the material under Region Four conditions. The test was conducted in the South Fork of Iron Creek about 25 miles south of Salmon, Idaho, on the Salmon National Forest.

Light to heavily infested stands of Douglas-fir in a 1,000 acre plot in the South Fork of Iron Creek received an aerial application spray of four ounces (actual) Cygon per acre in one gallon of cycle oil. A control plot located in adjacent Peel Tree Creek was used for comparison. The test plot was sprayed on July 14, 1964.

The weather was ideal at the time of application and during the remaining 20 days of sampling. The spray was applied by a TMB aircraft, and coverage was good.

Spot checks were made immediately after the spray application and also the following day. No initial knockdown was noted. Sampling checks were made at five-, ten-, fifteen-, and twenty-day intervals following the spray application date. Some mortality was noted during the later checks but the amount was insufficient to be considered satisfactory for control.

II. PURPOSE OF THE TEST

The purpose of the test was to determine the effectiveness of four ounces (actual) dimethoate in cycle oil per acre for control of the spruce budworm, Choristoneura fumiferana (Clem.), as applied under normal field conditions with fixed-wing aircraft.

III. METHODS AND PROCEDURES

A. ASSIGNMENT

Personnel within the Division of Timber Management, Branch of Forest Insect and Disease Prevention and Control were responsible for the planning, conduction, and followup of the test. The Forest Supervisor of the Salmon National Forest, where the test was conducted and other personnel assigned to the Salmon Unit of the 1964 Spruce Budworm Control Project aided in the test. Project Entomologist, C. K. Lister, conducted the test and Willard E. Mineau was in charge of the field work.

D. E. Parker and W. E. Cole, Division of Forest Insect Research of the Intermountain Forest and Range Experiment Station, assisted in the design of the study and provided consultation services.

Alec Sinclair of the American Cyanamid Company provided technical assistance in the formulation of the spray solution.

The Cygon test was conducted on a 1,000-acre test plot and a control plot of about 500 acres within the South Fork of Iron Creek and Peel Tree Creek Drainages, respectively, on the Salmon National Forest about 25 miles south and west of Salmon, Idaho, (See Appendix map).

B. TIME AND MONEY REQUIREMENTS

The spraying operation was carried out on July 14, 1964.

<u>Man-Days</u>	<u>Salaries & Per Diem</u>	<u>Trans- portation</u>	<u>Spray Application</u>	<u>Insecti- cide</u>	<u>Supplies Services</u>	<u>Total</u>
216	\$4,900.00	\$600.00	\$670.00	0	\$200.00	\$6,370.00

Funds were made available as a part of the allotment provided for the Region Four Spruce Budworm Control Project. The major DDT spray area was north and west of the Cygon test area and no DDT spraying was done within seven miles of the Cygon test area. The Cygon concentrate was donated by the American Cyanamid Company.

C. METHODS

The field operation consisted of five phases:

First--LOCATION AND BIAS SELECTION OF SAMPLE TREES WITHIN THE TEST AND CONTROL PLOTS.

Second--BUDWORM DEVELOPMENT SAMPLING AND RELEASE FOR TEST PLOT SPRAY.

Third--PRESPRAY POPULATION SAMPLING FOR PERCENTAGE AND SEQUENTIAL DENSITY COUNTS AND ESTABLISHMENT OF DEFOLIATION CLASS.

Fourth--APPLICATION OF CYGON BY TBM AIRCRAFT.

Fifth--POSTSPRAY POPULATION SAMPLING FOR PERCENTAGE AND SEQUENTIAL DENSITY COUNTS AT FIVE-, TEN-, FIFTEEN-, AND TWENTY-DAY INTERVALS AS WELL AS RETRIEVING OF SPRAY CARDS.

FIRST PHASE - LOCATION AND BIAS SELECTION OF SAMPLE TREES WITHIN THE TEST AND CONTROL PLOTS.

1. Location of Sample Trees within the Test and Control Plots.

Ten thread lines approximately 10 to 12 chains apart were run in a generally east-west direction, parallel to one another, across the test plot and control plot drainages. The ten lines in the test plot were run so no point on any line would be closer than three chains to the plot boundaries.

2. Bias Selection of Sample Trees within the Test and Control Plots.

Five trees per line were selected and tagged with card tags and orange and white flagging tape. A total of 50 sample trees per plot were selected. Sample trees were picked for relatively high insect population, abundant foliage, and a lack of foliage shading by adjacent trees.

SECOND PHASE - BUDWORM DEVELOPMENT SAMPLING AND RELEASE FOR TEST PLOT SPRAY

1. Daily Collection of Larvae Samples

Head-width measurements of budworm larvae from daily collections were used to determine the rate of development. Procedures were as follows:

- a. The entomologist established two collection plots, one at each end of the test plot. One was located at the lower 5,800-foot level; and the other one was located at the upper 7,000-foot level.
- b. The entomologist marked the location of the collection plots on a map of the drainage.
- c. An insect checker made daily collections of 100 larvae starting about a week or ten days after the insect broke hibernation.
- d. Collected larvae and pupae were placed in a vial containing 70 percent ethyl alcohol; the vial was labeled as to date, elevation, and collector's initials.
- e. Collections were delivered to the entomologist at the end of each day.
- f. The entomologist measured the head capsules with a binocular microscope to determine instar of each larva.

2. Release of Test Plot

The following guides were used by the entomologist in determining the test plot release date for spraying:

- a. Comparisons were made with head width measurement standards to determine daily the percent of each day's sample in each instar.
- b. When the percentage of third instar larvae was found to be down to 10 to 15 percent, the start of spraying operations was calculated to be 10 days away. Based on this data, the entomologist determined the date when the airplane should be made available to spray, and prespray population counts made.
- c. The plot was considered ready for spraying when the new growth expanded and daily collections showed approximately the following development:

<u>Instar</u>	<u>Percent</u>
2	0
3	1-5
4	40-45
5	45-50
6	1-5

THIRD PHASE - PRESPRAY POPULATION SAMPLING FOR PERCENTAGE AND SEQUENTIAL DENSITY COUNTS AND ESTABLISHMENT OF DEFOLIATION CLASS.

1. Prespray Population Sampling for Percentage Counts.

Two days prior to spraying, four 15-inch twigs were clipped from each sample tree close to where oil spray cards were attached. Each twig was clipped into a collecting cloth and closely examined for all live larvae, pupae, and freshly abandoned pupal cases. The larvae and pupae were counted and recorded for each sample tree, or for each set of four twigs.

2. Prespray Population Sampling for Sequential Density Counts.

Around each sample tree other trees were sampled sequentially to establish the precontrol larvae population. The cumulative number of larvae and pupae for each set of five 15-inch twigs was compared with the sequential table (Table I) until this total fell into one of three classes. When this occurred, sampling stopped. The area was classified as to the degree of infestation and sampling was started around the next sample tree.

3. Establishment of Defoliation Class

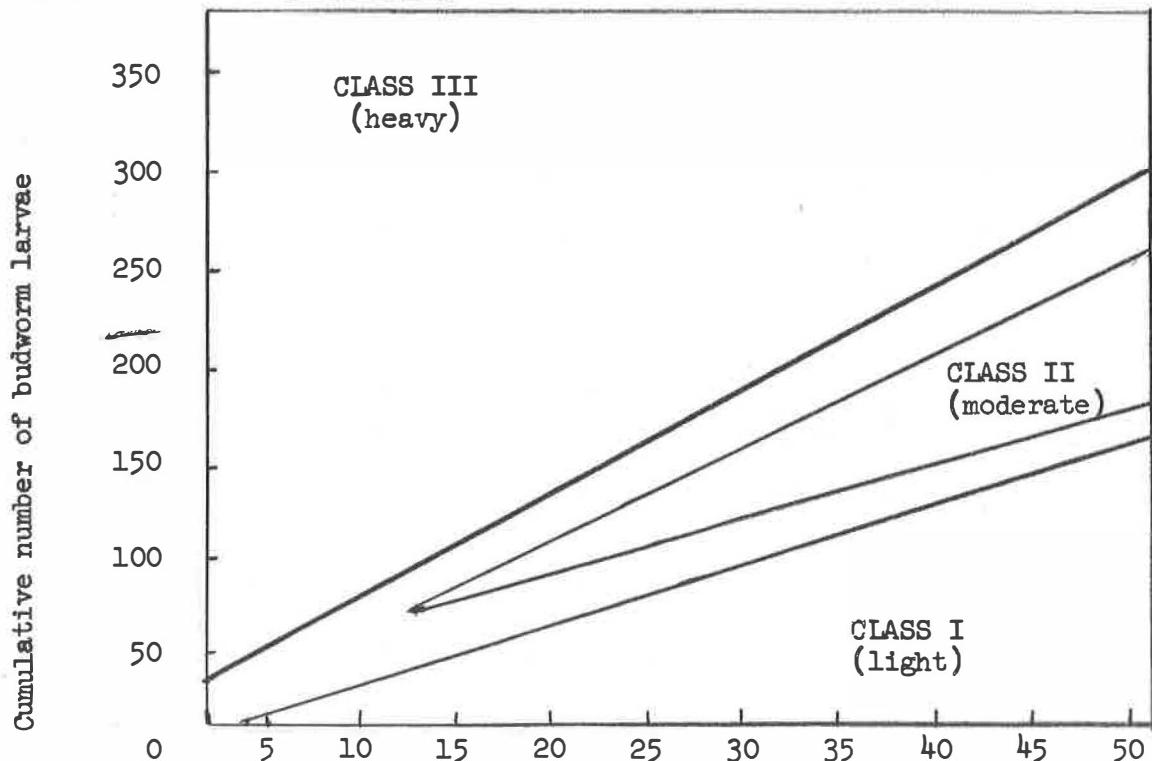
The defoliation class was determined by taking one 15-inch twig from each sample tree and finding the percentage of mined buds to total buds and classifying in accordance with the following:

0 - 25	Very light
25 - 50	Light
50 - 75	Medium
75 - 100	Heavy

TABLE I - Sequential table for field use in precontrol sampling of spruce budworm larvae populations.

Number of twigs examined	Cumulative number of budworm larvae					
	Class I	vs.	Class II	Class II	vs.	Class III
5	5		19	7		48
10	17		32	34		75
15	30		44	62		103
20	42		56	89		130
25	54		68	116		158
30	67		81	144		185
35	79		93	171		212
40	91		105	198		240
45	103		118	226		267
50	116		130	253		294

Sequential Graph for precontrol sampling of spruce budworm populations.



FOURTH PHASE - APPLICATION OF CYGON BY TBM AIRCRAFT1. Loading of Cygon in TBM Aircraft

The loading of Cygon was preceded by careful flushing of both airplane and mixing tank systems with Nutrasol. The Cygon was mixed by introducing 137.5 gallons of two pounds actual material per gallon into 962.5 gallons of cycle oil for a total of 1,100 gallons of insecticide and recirculating in the mixing tank. The procedure was as follows:

- a. An unused war surplus aircraft fuel tank was filled with water to its 830 gallon capacity. Eight pounds of Nutrasol were added, and the mixture recirculated and allowed to stand.
- b. The Nutrasol mixture in the tank was then flushed into the insecticide tank of the TBM aircraft and allowed to stand for 15 minutes.
- c. The TBM was started and the spray system ground operated until it was empty.
- d. A pure water flush was used three times to cleanse both systems of Nutrasol solution.
- e. The Cygon and cycle oil were mixed in two batches using 137.5 gallons of two pounds actual material per gallon and 962.5 gallons of cycle oil for a total of 1,100 gallons of insecticide.
- f. The material was recirculated in the mixing tank and loaded aboard the TBM aircraft.

2. Spray Deposit Cards

- a. Two days before spray application, four oil sensitive cards and four Walker blotter cards were pinned with clothespins and stapled to sample tree twigs in the test plot at breast height. The cards were placed side by side in pairs (one of each type) in about the same plane of circumference of the sample tree approximately 90° apart.
 - b. One oil sensitive card was placed on each sample tree in the control plot to check for unwanted spray from stray aircraft.
 - c. The day following the spray application all cards were picked up by the same men who established the cards.
 - d. Spray cards used for this test were 4x5 rectangles of 65 pound weight Kromekote cover stock and a special 4x5 Walker blotter paper backed by cardboard of the same size for later precision analysis of rate of application.
3. The test area contained a spray plot (test plot) and control plot. The spray plot was located on the South Fork of Iron Creek, and the control plot on another fork called Peel Tree Creek.

IV. RESULTS

A. Precontrol Sampling

- Spruce budworm infestations in the test plot and control plot were classed as light to heavy. The test plot was somewhat more heavily infested than the control plot. (See Tables III and IV)

TABLE III - Budworm infestation sequential class of sample trees.

	Class I (Light)	Class II (Medium)	Class III (Heavy)	Total Trees
Test Plot	1	15	34	50
Control Plot	11	27	12	50

- The sample trees in both plots were sampled for defoliation class. (See Table IV)

TABLE IV - Defoliation class for sample trees.

	V. Light	Light	Medium	Heavy	Trees Total
Test Plot	2	14	15	19	50
Control Plot	21	21	7	1	50

- The sample trees in both plots were sampled for a larval count using four 15-inch twigs per tree. (See Table V)

TABLE V - Prespray count of budworm larvae.

	Total Twigs Examined	Total Insects
Test Plot	200	1,900
Control Plot	200	879

B. Postcontrol Sampling

To establish a percentage control figure, Abbott's formula was used with collected data.

$$\begin{aligned}
 X &= \% \text{ living larvae in control plot} \\
 Y &= \% \text{ living larvae in test plot} \\
 X - Y &= \% \text{ kill by treatment}
 \end{aligned}$$

The application of the insecticide by the TBM aircraft was adequate by normal project standards.

Cygon application with water in New Mexico, applied soon after the third instar had been reached did not show any residual effect. The results of this test, however, indicate that mortality resulted from residual action. It is, therefore, recommended that a future test of Cygon be made to study the residual action of the insecticide. This residual action may be either from systemic action or by external deposit on the foliage.

VI. CONCLUSIONS

Cygon (dimethoate) when applied at four ounces (actual) in oil against fourth-sixth instar spruce budworm larvae is not sufficiently effective to obtain satisfactory control.

